PAN-PACIFIC ENTOMOLOGIST
July, 1979, Vol. 55, No. 3, pp. 222–227

# SYSTEMATICS OF *SALDULA PALUSTRIS* (DOUGLAS) FROM THE OREGON COAST (HETEROPTERA: SALDIDAE)

M. W. Stock
Dept. of Forest Resources, Univ. of Idaho, Moscow 83843

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The *Saldula pallipes-palustris* species complex has presented problems to the systematic heteropterist for some time. Douglas first described *S. palustris* in England in 1874 but its status as a valid species was not at first generally accepted. Many authors considered it merely a small, dark, coastal variety of *S. pallipes* (F.), a common and well-known European species. Later, Wagner (1950) and Cobben (1960a) described characters of the male genitalia and wings useful for separating the two species. Cobben (1960a) pointed out, however, that differentiating species from the New World on the basis of these characters is difficult and there is some evidence that the species complex here is not the same as it is in Europe.

Further confusion arises from habitat differences between certain groups of insects identified as *S. palustris* in North America. In Europe, *S. palustris* is exclusively halophilous, inhabiting estuarine mud flats, while *S. pallipes* is usually found inland. In North America, many specimens collected at inland locations have been identified as *S. palustris* (Chapman, 1962; Brooks and Kelton, 1967; Schuh, 1967; Bahr and Schulte, 1976).

In 1949, Drake described a new coastal species, *S. fernaldi,* from mud flats in Newfoundland. Drake and Hottes (1950) reported examining specimens of this species from tidal mud flats along the west coast of North America, including Oregon. Drake (1952) mentioned the presence of this species in Alaska. In 1962, Drake suppressed *fernaldi* as a synonym after examining more specimens of *S. palustris* from Europe and from both inland and coastal North America and concluding that they were a single species. Using available keys, Stock and Lattin (1976) identified a species of Saldidae, abundant on intertidal mud flats along the Oregon coast, as *S. palustris*. This insect is readily separated from other coastal Oregon saldids by its relatively large size and the dense golden pubescence on the anterior half of the forewings. Preliminary comparisons of this insect with European *S. palustris,* however, suggested that they might not be the same species and the work described here was undertaken.

## Distribution

*Saldula palustris* on the Pacific coast is exclusively halophilous and is well-adapted to the intertidal habitat (Stock and Lattin, 1976). The species

has been collected along the entire length of the Oregon coast. While the insects are abundant near the mouth of the Alsea and Yaquina Rivers, no *S. palustris* were found above head-of-tide on these rivers. Examination of the Oregon State University collection of several thousand Saldidae from the Pacific coast states (Oregon, Washington, California) revealed no specimens of *S. palustris* from other than coastal localities.

## Morphology

Morphological comparisons were made between European and American *S. pallipes* and *S. palustris*. Many structural features of the coastal Oregon species identified as *S. palustris* were very different from those of European *S. palustris*.

Differences in length of the hairs on the processus sensualis of the parameres ('claspers') are used to differentiate *S. palustris* from *S. pallipes* in Europe (Cobben, 1960a), the former having short hairs and the latter having long hairs (Fig. 1a, b). Cobben (1960b) used this character to identify a Caribbean saldid as *S. 'palustris'* (Fig. 1c). *Saldula pallipes* and *S. palustris* from the Baltic coast could be differentiated by this character (Lindskog, 1974). American authors, however, have found characters of the male genitalia of little use in differentiating the two species (Usinger, 1956; Brooks and Kelton, 1967; Schuh, 1967).

In our dissections, all parameres of Oregon *S. palustris* had long hairs on the processus sensualis (Fig. 1g) although European specimens had short hairs as described by Cobben (Fig. 1d). Dissected specimens of European *S. pallipes* had long hairs (Fig. 1e) as described by Cobben (1960a) but only 5 of 9 specimens of *S. pallipes* from Oregon had long hairs (Fig. 1h). Parameres of *S. fernaldi* had long hairs (Drake and Hottes, 1950) (Fig. 1f).

Other features of the male genitalia (the penisfilum, the shape of the aedeagus, and the median sclerotized structure of the aedeagus) and the subgenital plate of the female appear similar in both European and Oregon *S. palustris*.

## Wing Characteristics

*Pubescence*.—The type of pubescence on the hemelytra is considered a reliable specific character by some authors (e.g., Brooks and Kelton, 1967). Drake and Hottes (1950) distinguished *S. fernaldi* from *S. pallipes* by "the longer, denser, golden pubescence on the hemelytra." Dense golden pubescence, continuous across the anterior half of the hemelytra, is a conspicuous and unique characteristic of Oregon *S. palustris*. In European *S. palustris,* the golden hairs are visible along the clavus and exocorium of the wing but not on the endocorium. That is, the pubescence is interrupted by an inverted V-shaped wedge up the middle of the corium. A similar inter-

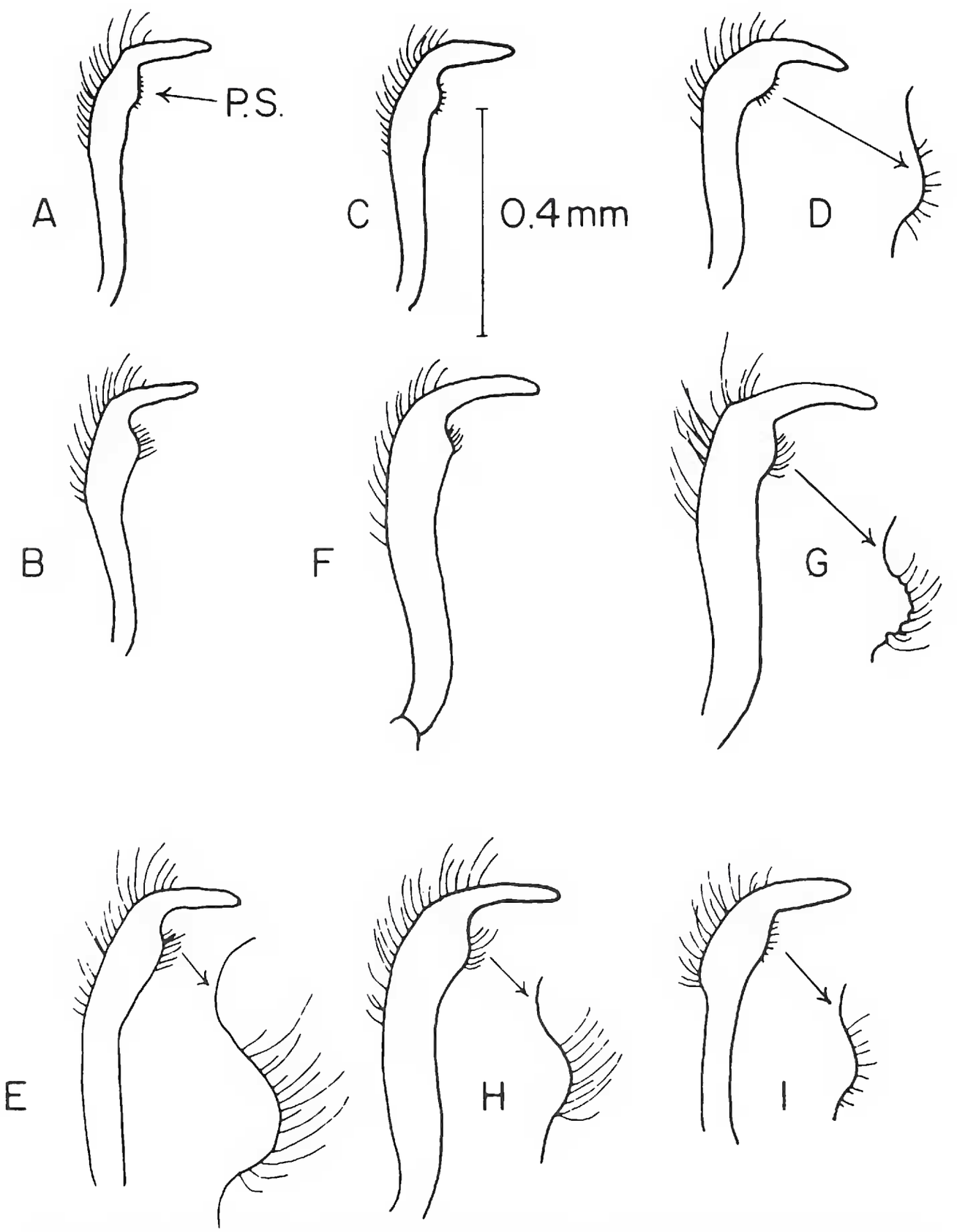


Fig. 1. Parameres of male *S. palustris, S. pallipes,* and *S. fernaldi,* showing differences in length of hairs on the processus sensualis (p.s.). Drawings are not to scale. a. European *S. palustris* (after Cobben, 1960a). b. European *S. pallipes* (after Cobben, 1960a). c. Caribbean *S. 'palustris'* (after Cobben, 1960b). d. European *S. palustris* (my dissections). e. European *S. pallipes* (my dissections). f. *S. fernaldi* (after Drake and Hottes, 1950). g. Oregon *S. palustris* (my dissections). h. Oregon *S. pallipes* (my dissections) showing long- and short-haired conditions found.

ruption of wing pubescence is seen in Oregon *S. pallipes*. Lindskog (1974) noted that *S. palustris* in Scandinavia has hemelytra covered by denser, longer pubescence than *S. pallipes*.

*Pigmentation*.—*S. palustris* and *S. pallipes* have been separated with some success in Europe by use of a eunomic wing series for the forewings or hemelytra (Wagner, 1950). The eunomic series is based on the idea that the species can be characterized by a series of wings expressing the range of pigmentation seen in the species. Wagner (1950) considered the pale or dark types of the hemelytra the only single certain differentiating character between European *S. palustris* and *S. pallipes*. Lindskog (1974) observed, however, that the range of variation within a species and the overlap between species is more extensive than Wagner suggested and since single specimens often turn up, the species cannot be identified reliably by this character. Other work (Stock, 1972) demonstrated that much of this large amount of pigmentation variation within the species *S. palustris* from Oregon is environmentally induced.

Lindskog (1974) noted that in *S. pallipes* the pale markings may be almost white, whereas those of *S. palustris* are generally more yellowish. However, yellowing of the wings of Oregon *S. palustris* occurs with age and cannot be considered a species character (Stock and Lattin, 1976).

Two wing pattern characteristics appear consistently in both Oregon and European *S. palustris* and are not seen in Oregon and European *S. pallipes*. The first character is an L-shaped pale strip along the inner margin of the lower exocorium. The strip merges with the two white spots of the exocorium only in very pale individuals. The second characteristic pale strip is seen along the outer edge of the lower exocorium and is often separated into two smaller, pale markings in darker individuals. In Oregon specimens, orange coloration of this second marking is common in *S. palustris* but not *S. pallipes*.

## Size

Large size (about 4.7 mm) is a conspicuous character of Oregon *S. palustris* relative to other coastal Oregon saldid species, including *S. pallipes*. The type specimen of *S. fernaldi* is 4.25 mm long. According to the literature, *S. palustris* in North America is generally larger than *S. pallipes* (Chapman, 1962; Brooks and Kelton, 1967) while the reverse is true in Europe where *S. palustris* is usually less than 4 mm long (Cobben, 1960a).

## Other Characters

Foretibial and antennal markings and spines on the hind femora were not conspicuously different in the groups compared. Spots along the sides of the femora (characteristic of *Saldula* spp. in general) were observed in all

specimens but appeared more distinct, numerous, and regular in Oregon *S. palustris* than in any other group.

Brooks and Kelton (1967) used the callosities of the head as a species-differentiating character for Canadian *S. palustris* and *S. pallipes* but the Oregon species could not be distinguished on this basis. The callosities of both European species appeared narrower and longer than those of Oregon species but since the extent of pigmentation on these structures varies, actual size and shape were difficult to distinguish.

A structure on the side of the abdomen of male Saldidae, originally described as a stridulatory organ (Drake and Hottes, 1951), is used during mating to grasp the edge of the female forewing (Cobben, 1957). This grasping organ bears a series of peg- and/or spine-like structures, the number of which is variable within and among species. European *S. palustris* has 16–22 (Cobben, 1957). The structure may have value in species differentiation when it has been studied in more detail. Electron micrographs have revealed details of structure (e.g., V-shaped sculpturing of the pegs) not previously described and have shown that Oregon *S. palustris* may have up to 24, and possibly more, pegs (Stock, 1972).

## Discussion

Evidence presented here indicates that the coastal Oregon species identified as *S. palustris* is not the same as the European species of that name. The key differentiating character—length of hairs on the male parameres—is not the same in the two groups. The hairs are long on the Oregon insects and short in the European species. In addition, the Oregon species is considerably larger than the European species and has longer, more golden pubescence on the forewings.

Several similarities exist between the Oregon species and insects named *S. fernaldi* in the past. They share characteristics of long golden pubescence on the forewings, an exclusively coastal distribution, parameres with long hairs, and large size. I therefore suggest that the Oregon insects are not *Saldula palustris* and that the name *S. fernaldi* should be revived and applied to this species.

## Acknowledgments

I thank Dr. J. D. Lattin for his advice and support during this study, and Dr. R. H. Cobben for providing specimens of European *S. palustris* and *S. pallipes*.

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